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Preliminary Results of Radioactivity Sampling at Landfills

Background

Regional Water Boards do not require water quality sampling for radioactivity for the approximately 500 landfills regulated under waste discharge requirements. More than half of the 500 landfills are closed but still subject to groundwater monitoring requirements.

Selection of Landfills and Request for Sampling

In order to determine whether landfills are discharging radioactivity into groundwater, the State Water Board worked with Regional Water Boards to select a representative sample of municipal landfills throughout the state and collect water quality data on radioactivity. Thirty-five municipal landfills were selected. The Santa Ana Regional Water Board elected to place 14 additional landfills on the list and Assembly Member Pavley requested addition of the Calabasas landfill in the Los Angeles Region. Therefore, the final list included 50 landfills ([see attached map](#)). Of the 50 landfills, 26 were lined and 24 were unlined. This number is approximately 10% of the approximately 500 regulated landfills. On April 25, 2002, the State Water Board requested ([see attached spreadsheet](#)) Regional Water Boards to require landfill operators to conduct radioactivity water quality sampling and analyses at the selected municipal landfills.

Sampling Protocol

Water samples were required to be obtained from (1) leachate (at lined landfills having a leachate collection and recovery system); (2) potentially impacted groundwater wells (those immediately downgradient from waste disposal cells); and (3) from background (upgradient) groundwater monitoring wells. The water samples were then to be analyzed for the following common radioactivity measures:

- **Gross alpha particle activity** – Gross alpha particle activity is a measure of the total amount of radioactivity in a water sample attributable to the radioactive decay of alpha-emitting elements - **most often associated with the decay of uranium and to a lesser extent, radium.**
- **Gross beta particle activity** – Gross beta particle activity is a measure of the total amount of radioactivity in a water sample attributable to the radioactive decay of beta-emitting elements - **most often associated with the decay of tritium.**
- **Tritium** – Tritium is an isotope of hydrogen that has one proton and two neutrons. Upon decay, it emits low energy beta particles (electrons) only and has a half-life of 12.3 years. A 12.3 year-old “Exit” sign that contains tritium will contain half as much tritium due to decay.

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Maximum Contaminant Levels (MCLs)

Landfill sampling preliminary results were compared to MCLs established for drinking water by the USEPA and Department of Health Services. The MCLs for radioactivity in picoCuries per liter are:

- | | |
|-------------------------|--------|
| • Gross Alpha Particles | 15 |
| • Gross Beta Particles | 50 |
| • Tritium | 20,000 |
| • Radium 226 | 3 |
| • Radium 228 | 2 |
| • Uranium | 20 |

Preliminary Results – 26 Lined Landfills

- ◆ Twenty-five of the 50 landfills are composite-lined, one is clay lined. All are open and accepting waste. It is important to note that many of these landfills have unlined disposal units, some of which may still be accepting waste. Also note that a composite liner is engineered plastic sheeting, underlain by compacted clay to minimize leakage in the event of a tear in the plastic. The liner is overlain by a gravel layer and piping which collects and removes leachate from the landfill. Leachate was collected for sampling to determine the level of radioactivity in the landfill. Leachate is not required to meet MCLs, as it is not a source of drinking water.
- ◆ Of the 26 lined landfills, the leachate in 16 exceeded drinking water MCLs for at least one radioactivity measurement. At 25 of the 26, landfill leachate did not appear to contribute to any downgradient groundwater radioactivity. The Newby Island landfill in Fremont showed leachate **and** surrounding groundwater exceeding the MCL for gross beta emissions. However, additional testing may be necessary to determine whether the groundwater sample taken represented background or downgradient radioactivity. This landfill is in the salt flats of South San Francisco Bay where the groundwater has twice the salt content of seawater.

Preliminary Results – 24 Unlined Landfills

- Twenty-four of the 50 landfills are unlined. Thirteen of the 24 unlined landfills are closed and do not accept waste.
- Unlined landfills do not have leachate collection systems. Therefore, upgradient and downgradient groundwater samples were taken and analyzed.
 - Of the twenty-four unlined landfills, six had downgradient exceedences of a radioactivity MCL that also exceeded background groundwater water quality. Four of the 6 are closed and the other 2 are open and accepting waste. Additional

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investigation may be required at these 6 unlined landfills to further assess these preliminary results. Note that all 6 exceeded the MCL for gross alpha particles, which is most associated with decaying uranium or radium.

Additional Comments

- Upgradient **and** downgradient groundwater preliminary results should take into consideration the fact that almost 500 active public water supply wells have exceeded at least one radioactivity MCL over the last 8 years. Naturally occurring uranium and its daughter elements (radium, etc.) may account for most if not all the MCL exceedences in public supply wells. ([See map attached.](#))
- More comprehensive sampling or review of other nearby water supply analyses may be warranted to determine if background radioactivity was the source of the gross alpha particle MCL exceedences in groundwater. This may also require additional analyses of the uranium isotope to determine if the uranium was naturally occurring in the background.
- Additional testing may be required to determine if reported levels of tritium are anomalous. One of the characteristics of this hydrogen isotope is its ability to rapidly bind to water. Sources may include improperly discarded luminous signs and other commercial applications. Tritium detection requires highly specialized equipment. It is important to note that tritium has not been detected in any downgradient water tested. Tritium has been detected (above the MCL) in the leachate of 12 landfills and the upgradient groundwater of one closed landfill.
- The federal government (NRC license) requires that signs with tritium be returned to their manufacturers and prohibits their disposal in any landfill.

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